Biotechnology

Course Description

This course equips students with a working knowledge of biotechnology as it is used in Agricultural, Food, Natural Resources, and Health Sciences. Students will diagram how classical processes have influenced trait improvement throughout history. Through application of DNA structure and gene insertion methods, students will demonstrate how genetic engineering has been applied to organism improvement and solving human health issues. Students will apply DNA and protein detection to determine presence of specific traits. Additionally, students will distinguish between scientific and societal biotechnology issues. Classroom and laboratory activities are supplemented through supervised agricultural experiences and leadership programs and activities.

Course Code: 012004

Program(s) of Study to which this course applies

- Biotechnology

Course Content	Crosswalk to Common Core Academic Standards	Crosswalk to Nebraska Academic Standards	Crosswalk Clarification
Standard 1. Students will identify classical trait selection processes and their historical and current application in biotechnology.			
Benchmark 1.1 Demonstrate how the process of selection is used in developing organisms with desired traits. <u>Sample performance indicators:</u> • Select strains of yeast that have optimal fermenting characteristics. • List characteristics that would be desired in an organism.	ELA.RST.11-12.3	LA.12.3.2 LA.12.2.6.k SC.12.3.2.a	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.3.2, LA.12.1.6.k). Alignment with science standard presumes that students will evaluate trait selection and identify how information (DNA) is passed from parents to offspring (NE: SC.12.3.2.a).

Course Content	Crosswalk to Common Core Academic Standards	Crosswalk to Nebraska Academic Standards	Crosswalk Clarification
Benchmark 1.2 Explain the role of classical breeding processes in improving organisms throughout history. Sample performance indicators: • Outline the process breeders would follow starting with a unique behavior or production trait in a parent. • Identify the limits of classical breeding.	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students *explain* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject. (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Benchmark 1.3 Describe how classical breeding and trait selection processes are used in health and agricultural industries. Sample performance indicators: • Identify time efficiency strategies that can improve plant, animal, and bacteria breeding. • Recognize the relative challenge when breeding for complex versus simply controlled traits.	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Standard 2. Students will evaluate the application of genetic engineering to solve and improve agricultural and health issues.			
Benchmark 2.1 Outline the processes by which organisms are genetically engineered. Sample performance indicators: • Create a plan to produce a transgenic organism containing a desired trait. • Identify the most difficult steps in creating a genetically engineered organism.	N/A	SC.12.3.2.a SC.12.3.2.b	Alignment presumes students will address basic concepts about DNA (that DNA is passed from parents to offspring; the function of DNA in genetic inheritance) when outlining the genetic engineering process (NE: SC.12.3.2.a & b).
Benchmark 2.2 Identify how gene discovery is critical in genetic engineering. Sample performance indicators: • Propose an organism that naturally contains a gene that would be valuable in genetic engineering project. • Justify why scientists study and identify genes.	N/A	SC.12.3.2.b	Alignment presumes students will describe the basic structure and function of DNA as it relates to genes (NE: SC.12.3.2.b).

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Benchmark 2.3 Employ gene design strategies that will result in desired transgene expression. Sample performance indicators: • Predict how a transgene will be expressed given the transgene design. • Describe the importance of the universal genetic code in genetic engineering.	ELA.RST.11-12.3	LA.12.3.2 LA.12.2.6.k	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.3.2, LA.12.1.6.k).
Standard 3. Students will use biotechnology diagnostics to monitor and evaluate procedures performed in industry systems.			
Benchmark 3.1 Diagram the relationship of how genes encode proteins and proteins determine traits. Sample performance indicators: • Explain why DNA and protein testing is more reliable than testing for a trait. • Explain why mutations in proteins can result in changes in proteins and how these mutations can be detected.	N/A	SC.12.1.1.d SC.12.3.1.c SC.12.3.2.a SC.12.3.2.b SC.12.3.2.c	Alignment presumes students will select appropriate technology for protein testing and recognize how mutations can have an effect on organisms (NE: SC.12.1.1.d, SC.12.3.2.c).
Benchmark 3.2 Plan a diagnostic strategy to detect genes or proteins that control important traits. Sample performance indicators: • Identify which molecules are detected with PCR and which are detected with antibodies. • Choose the time and tissue for a diagnostic test on an organism.	N/A	SC.12.1.1.b	
Benchmark 3.3 Select the proper laboratory equipment and outline the test for the situation. Sample performance indicators: • Pick the appropriate laboratory equipment from a supply catalog for a diagnostic test. • Arrange procedures in their proper order for a diagnostic test.	ELA.RST.11-12.3	LA.12.3.2 LA.12.2.6.k SC.12.1.1.d	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.3.2, LA.12.1.6.k).

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Standard 4. Students will analyze the ethical, legal, scientific, social and cultural issues relating to biotechnology.			
Benchmark 4.1 Differentiate between ethical, legal, scientific, social and cultural issues relating to biotechnology. Sample performance indicators: • Identify if a regulatory agency should examine a particular issue. • Determine if there is a valid scientific basis for a biotechnology issue.	N/A	SC1.12.1.2.b	
Benchmark 4.2 Research, evaluate, and articulate the implications of an ethical, legal, scientific, social and cultural biotechnology issue. Sample performance indicators: • Evaluate the benefits and risks associated with biotechnology. • Examine an ethical dilemma associated with biotechnology.	ELA.WHST.11-12.7-9	LA.12.4.1.a-c LA.12.1.6.j SC1.12.1.2.b	The depth of students' investigations, and thus the research standards that apply, will be determined by the nature of the task (CC: ELA.WHST.7-9; NE: LA.12.4.1, LA.12.1.6).

Reference Standards Sources

- KS = Career Clusters Knowledge and Skills Statements. Revised 2008. National Career and Technical Education Foundation, Silver Spring, MD. www.careerclusters.org.

Other Information

Suggestions for innovative teaching and learning strategies:	• Perform PCR and protein antibody test
Related assessments:	• Supervised Agricultural Experience (SAE)
Extended learning opportunities:	• FFA Career Development Events • Agricultural and Health industry tours

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